Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

AMENDMENTS TO THE CLAIMS

1.   (Currently Amended) A method for generating a wide image video sequence using a device having at least two video cameras substantially co-located in a predetermined relationship to each other such that there will be an overlap between images from the respective cameras, said method comprising the steps of:

a.   forming a synthetic image from images of the respective cameras by (i) identifying corresponding parts in overlapping parts of the images, (ii) determining the relation between the respective coordinates for the pixels in the individual cameras and in the synthetic image, and (iii) calculating calibration parameters from said relation, said calculated calibration parameters being unique for the at least two cameras and their current location as related to the object being recorded ~~generating a set of calibration parameters related to a device having at least two video cameras which are arranged in a predetermined relationship to each other, said parameters being unique for the at least two cameras and their current location as related to the object being recorded~~;

b.   ~~recording~~ synchronously recording video sequences using each of said at least two video cameras[[,]]; and

c.   generating a wide image video sequence by combining ~~from each of~~ said synchronously recorded video sequences using said calculated calibration parameters.

2   (Currently Amended) A method according to claim 1, wherein ~~in which~~ the synchronously recorded video sequences are stored in a memory storage area ~~means~~.

3.   (Currently Amended) A method according to claim 1, wherein ~~in which~~ the synchronously recorded video sequences are used concurrently for generating the wide image video sequence.

4.   (Currently Amended) A method according to claim 3, wherein ~~in which~~ the wide image video sequence is transmitted live.

LEGAL02/31293265v1

Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

5. (Currently Amended) A method according to claim 3, wherein ~~in which~~ the wide

image video sequence is stored on a memory **storage area** ~~means~~.

6. (Currently Amended) A method according to claim 1, **wherein calculating the**

calibration ~~in which the generation of calibration parameter~~; comprises the following steps:

a. ~~Start of~~ **starting a** calibration process;

b. ~~Synchronize~~ **synchronizing** the sequences from each **of the at least two**

cameras ~~camera, which means that at least a video sequence has to be recorded by all~~

~~cameras~~;

c. ~~Compute~~ **computing** inter-image projective transformations;

d. [[Use]] **using** the transformations to refer each image to a common reference

frame;

e. ~~Choose~~ **selecting** a real or virtual reference camera such that certain lines on the

pitch ~~and/or~~ **or** stadium are **substantially** ~~essentially~~ horizontal and **substantially** parallel in the

wide image;

f. ~~Select~~ **selecting** a rectangular region of interest within the wide image. ~~This~~

~~region contains e.g. the entire pitch and as much of the stadium as is required or visible~~;

and

g. [[Record]] **storing the** [[all]] computed values resulting from the calibration

process to be used as the calibration parameters.

7. (Currently Amended) A method according to claim 6 **further comprising the**

step of determining ~~in which the steps of finding the~~ lens distortion **parameters** ~~parameter(s)~~

for each camera, and correcting radial distortion in each image ~~produced are comprised~~.

8. (Currently Amended) A method according to claim 6 **further comprising the**

step of ~~in which the step of~~ selecting non-linear distortion parameters to reduce perspective

distortion of the wide image ~~is comprised~~.

9. (Canceled)

LEGAL02/31203265v1

Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

10. (Currently Amended) A method Method according to claim 1 in which step b is performed automatically by an algorithm for identification of co responding features in concurrent video images and the coordinates for these the corre:.ponding features are input via [[to]] a computer means.

11. (Currently Amended) A method Method accord ng to claim 1 which further comprising performing the following steps until completing the generation of the wide image video sequence comprises the following steps:

a. applying Apply the calculated computed and registered calibration parameters:[[.]]

b. until the end of the sequence is reached, for [[For]] each pixel in the wide image, computing compute and storing store parameters describing (1) which 1. Which pixels from which images image(s) contributes contribute to [[this]] the respective pixels [[pixel]] in the wide image[[.]] and (2) how 2. How much each of the respective pixels contributes these pixels each contribute to the wide image;

b. Repeat until the end of the sequence is reached;

c. retrieving Obtain one new image from each camera;

d. selectively If required, update updating the parameters needed to transform intensities (colours/brightness) in one or more of the cameras to eliminate visible seams;

e. selectively If necessary, adjust the adjusting intensities (colours/brightness) in the images from one or more of the cameras; and

f. creating Create the current seamless, wide image from the current images from each camera;

g. outputting Output the wide image to a display or to a memory storage area means.[[; and]]

h. End of sequence. Return to step b until end of generation of the wide image video sequence.

LEGAL02/31293265v1

Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

12. (Currently Amended) <u>A method</u> ~~Method~~ according to claim 11, wherein the new images from each camera are read from live sources, each such source comprising a video camera.

13. (Currently Amended) <u>A method</u> ~~Method~~ accord ng to claim 11 wherein the new images from each video camera are read from a memory <u>storage area</u> ~~means~~.

14. (Currently Amended) <u>A device having at least two video cameras substantially co-located and arranged in a predetermined relationship to each other such that there will be an overlap between images from the respective cameras, a processor, at least one memory storage area, wherein the processor is configured to</u> ~~In a device having a processor means, which executes instructions stored in at least one memory means, a method for generating video sequences comprising the steps of~~:

    a. <u>form a synthetic image from images of the respective cameras by (i) identifying corresponding parts in overlapping parts of the images, (ii) determining the relation between the respective coordinates for the pixels in the individual cameras and in the synthetic image, and (iii) calculating calibration parameters from said relation, said calculated calibration parameters being unique for the at least two cameras and their current location as related to the object being recorded</u> ~~generating a set of calibration parameters related to a device having at least two video cameras which are arranged in a predetermined relationship to each other, said parameters being unique for the at least two cameras and their current location as related to the object being recorded~~;

    b. ~~recording~~ synchronously <u>record</u> video sequences using each of said at least two video cameras[[,]]; and

    c. <u>generate</u> ~~generating~~ a wide image video sequence <u>by combining</u> ~~from each of~~ said synchronously recorded video sequences <u>using said calculated calibration parameters</u>.

15. (Currently Amended) <u>The device of</u> ~~In a device according to~~ claim 14, <u>wherein the method in which</u> the synchronously recorded video sequences are stored in <u>a memory storage area</u> ~~a memory means~~.

6 of 20

LEGAL.02/31293265v1

Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

16. (Currently Amended) The device of ~~In a device according to~~ claim 14, wherein ~~the method in which~~ the synchronously recorded video sequences are used concurrently for generating the wide image video sequence.

17. (Currently Amended) The device of ~~In a device according to~~ claim 14, wherein ~~the method in which~~ to calculate ~~the method in which the generation of~~ calibration parameters, the processor is further configured to ~~comprises the following steps~~:

    a. ~~Start of~~ start a calibration process;

    b. ~~Synchronize~~ synchronize the sequences from each of the at least two cameras ~~camera, which means that at least a video sequence has to be recorded by all cameras~~;

    c. ~~Compute~~ compute inter-image projective transformations;

    d. [[Use]] use the transformations to refer each image to a common reference frame;

    e. ~~Choose~~ select a real or virtual reference camera such that certain lines on the pitch ~~and/or~~ or stadium are substantially ~~essentially~~ horizontal and substantially parallel in the wide image;

    f. ~~Select~~ select a rectangular region of interest within the wide image. ~~This region contains e.g. the entire pitch and as much of the stadium as is required or visible~~; and

    g. [[Record]] store the [[all]] computed values resulting from the calibration process to be used as the calibration parameters.

18. (Currently Amended) The device of ~~In a device according to~~ claim 14, wherein to calculate the ~~method in which the generation of~~ calibration parameters, the processor is further configured to determine ~~the following steps of finding the~~ lens distortion parameters ~~parameter(s)~~ for each camera, and correct ~~correcting~~ radial distortion in each image produced ~~are comprised~~.

19. (Currently Amended) The device of ~~In a device according to~~ claim 14, wherein to calculate the ~~method in which the generation of~~ calibration parameters, the processor is

LEGAL02/31293265v1

Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

further configured to select ~~the following step of selecting~~ non-linear distortion parameters to

reduce perspective distortion of the wide image ~~is comprised~~.

20.   (Canceled)

21.   (Currently Amended) **The device of** ~~In a device according to~~ claim 14, **wherein**
~~the method in which~~ step b is performed automatically by an algorithm for identification of
corresponding features in concurrent video images and the coordinates for these corresponding
features are input to a computer **storage area** ~~means~~.

22.   (Currently Amended) **The device of** ~~In a device according to~~ claim [[9]] **14**,
wherein the processor is further configured to ~~the method which comprises the following~~
~~steps~~:

a.   **apply** ~~Apply~~ the **calculated** ~~computed and registered~~ calibration
parameters**:**[[.]]

b.   **until the end of the sequence is reached, for** [[For]] each pixel in the wide
image, **compute** ~~compute~~ and **store** ~~store~~ parameters describing **(1) which** ~~1. Which~~ pixels
from which **images** ~~image(s) contributes~~ **contribute** to [[this]], **the respective pixels** [[pixel]]
in the wide image[[.]] **and (2) how** ~~2. How~~ much **each of the respective pixels contributes**
~~these pixels each contribute~~ to the wide image;

~~b.   Repeat until the end of the sequence is reached;~~

c.   **retrieve** ~~Obtain~~ one new image from each camera;

d.   **selectively** ~~If required, update~~ **update** the parameters needed to transform
intensities ~~(colours/brightness)~~ in one or more **of the** cameras to eliminate visible seams;

e.   **selectively** ~~If necessary, adjust the~~ **adjust** intensities ~~(colours/brightness)~~ in the
images from one or more **of the** cameras; **and**

f.   **create** ~~Create~~ the current seamless, wide image from the current images from
each camera;

g.   **output** ~~Output~~ the wide image to a display or to a memory **storage area**
~~means~~**.**[[; and]]

LEGAL02/31293265v1

b. ~~End of sequence. Return to step b until end of generation of the wide image~~ ~~video sequence~~.

23. (Currently Amended) **The device of** ~~In a device according to~~ claim 22, **wherein** ~~the method wherein~~ the new images from each camera are read from live sources, each such source comprising a video camera.

24. (Currently Amended) **The device of** ~~In a device according to~~ claim 22, **wherein** ~~the method wherein~~ the new images from each video camera are read from a memory **storage area** ~~means~~.

25. (Currently Amended) A computer ~~readable memory means storing a program~~ ~~for generating a wide image video sequence~~ **-readable medium having computer-readable** **program code portions stored therein, the computer-readable program code portions** **comprising executable portions that cause a device having at least two video cameras** **substantially co-located in a predetermined relationship to each other such that there will** **be an overlap between images from the respective cameras to** ~~which executes the steps of~~:

    a. **form a synthetic image from images of the respective cameras by (i)** **identifying corresponding parts in overlapping parts of the images, (ii) determining the** **relation between the respective coordinates for the pixels in the individual cameras and in** **the synthetic image, and (iii) calculating calibration parameters from said relation, said** **calculated calibration parameters being unique for the at least two cameras and their** **current location as related to the object being recorded** ~~generating a set of calibration~~ ~~parameters related to a device having at least two video cameras which are arranged in a~~ ~~predetermined relationship to each other, said parameters being unique for the at least two~~ ~~cameras and their current location as related to the object being recorded~~;

    b. ~~recording~~ synchronously **record** video sequences using each of said at least two video cameras[[,]]**;** and

    c. **generate** ~~generating~~ a wide image video sequence **by combining** ~~from each of~~ said synchronously recorded video sequences **using said calculated calibration parameters**.

Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

26. (Currently Amended) <u>The computer-readable medium of</u> ~~A memory means storing a program according to~~ claim [[17]] <u>25, wherein</u> ~~in which~~ the synchronously recorded video sequences are stored in a memory <u>storage area</u> ~~means~~.

27. (Currently Amended) <u>The computer-readable medium of</u> ~~A memory means storing a program according to~~ claim [[17]] <u>25, wherein</u> ~~in which~~ the synchronously recorded video sequences are used concurrently for generating the wide image video sequence.

28. (Currently Amended) <u>The computer-readable medium of</u> ~~A memory means storing a program according to~~ claim [[17,]] <u>25, wherein to calculate the</u> ~~in which the generation of~~ calibration parameters<u>, the computer-readable medium further comprises executable portions that cause the device to</u> ~~comprises the following steps~~:

    a. ~~Start of~~ <u>start a</u> calibration process;

    b. ~~Synchronize~~ <u>synchronize</u> the sequences from each <u>of the at least two cameras</u> ~~camera, which means that at least a video sequence has to be recorded by all cameras~~;

    c. ~~Compute~~ <u>compute</u> inter-image projective transformations;

    d. [[Use]] <u>use</u> the transformations to refer each image to a common reference frame;

    e. ~~Choose~~ <u>select</u> a real or virtual reference camera such that certain lines on the pitch ~~and/or~~ <u>or</u> stadium are <u>substantially</u> ~~essentially~~ horizontal and <u>substantially</u> parallel in the wide image;

    f. ~~Select~~ <u>select</u> a rectangular region of interest within the wide image. ~~This region contains e.g. the entire pitch and as much of the stadium as is required or visible~~; and

    g. [[Record]] <u>store the</u> [[all]] computed values resulting from the calibration process to be used as the calibration parameters.

29. (Currently Amended) <u>The computer-readable medium of claim 28, further comprising executable portions that cause the device to determine</u> ~~A memory means storing a program according to claim 28, in which steps of finding the~~ lens distortion

parameters parameter(s) for each camera, and correct correcting radial distortion in each image produced are comprised.

30. (Currently Amended) The computer-readable medium of claim 28, further comprising executable portions that cause the device to select A memory means storing a program according to claim 28, the step of selecting non-linear distortion parameters to reduce perspective distortion of the wide image is comprised.

31. (Canceled)

32. (Currently Amended) The computer-readable medium of claim 28, wherein A memory means storing a program according to claim 28, in which step b is performed automatically by an [[and]] algorithm for identification of corresponding features in concurrent video images and the coordinates for the these corresponding features are input to a computer means.

33. (Currently Amended) The computer-readable medium of claim 28, further comprising executable portions that cause the device to A memory means storing a program according to claim 28, which comprises the following steps:

a. apply Apply the calculated computed and registered calibration parameters;[[.]]

b. until the end of the sequence is reached, for [[For]] each pixel in the wide image, compute compute and store store parameters describing (1) which 1. Which pixels from which images image(s) contributes contribute to [[this]] the respective pixels [[pixel]] in the wide image[[.]] and (2) how 2. How much each of the respective pixels contributes these pixels each contribute to the wide image;

b.   Repeat until the end of the sequence is reached;

c. retrieve Obtain one new image from each camera;

d. selectively If required, update update the parameters needed to transform intensities (colours/brightness) in one or more of the cameras to eliminate visible seams;

Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

e.   selectively ~~If necessary, adjust the~~ adjust intensities ~~(colours/brightness)~~ in the images from one or more **of the** cameras; **and**

f.   **create** ~~Create~~ the current seamless, wide image from the current images from each camera;

g.   **output** ~~Output~~ the wide image to a display or to a memory **storage area** ~~means~~.[[; and]]

~~h.   End of sequence. Return to step b until end of generation of the wide image video sequence.~~

34.   (Currently Amended) **The computer-readable medium of claim 28,** ~~A memory means according to claim 28,~~ wherein the new images from each camera are read from live sources, each such source comprising a video camera.

35.   (Currently Amended) **The computer-readable medium of claim 28,** ~~A memory means according to claim 28,~~ wherein the new images from each video camera are read from a memory **storage area** ~~means~~.

36.   (Currently Amended) A video recording apparatus **having at least two video cameras substantially co-located in a predetermined relationship to each other such that there will be an overlap between images from the respective cameras, the video recording apparatus** comprising:

a **microprocessor (130);** ~~microprocessor(130),~~

a memory **storage area** ~~means~~ (120) [[for]] storing **a** program for**:** ~~generating a set of calibration parameters related to a device having at least two video cameras which are arranged in a predetermined relationship to each other, said parameters being unique for the at least two cameras and their current location as related to the object being recorded;~~

a.   **forming a synthetic image from images of the respective cameras by (i) identifying corresponding parts in overlapping parts of the images, (ii) determining the relation between the respective coordinates for the pixels in the individual cameras and in the synthetic image, and (iii) calculating calibration parameters from said relation, said**

12 of 20

LEGAL02/31293265v1

Appl. No.: 10/564,286
Amdt. dated May 11, 2009
Reply to Office Action of February 10, 2009

calculated calibration parameters being unique for the at least two cameras and their
current location as related to the object being recorded,

        b.   synchronously recording video sequences using each of said at least
two video cameras, and

        c.   generating a wide image video sequence by combining said
synchronously recorded video sequences using said calculated calibration parameters,

    ~~said memory means (120) also storing program for recording of wide image video
sequences;~~

    a read and write memory storage area ~~means~~ (140) for storing data relating to recorded
video sequences from the at least two video cameras;

    an input component [[means]] (300) for receiving ~~input of manual~~ input of parameters,
and input of recorded video sequences;[[,]] and

    an output component [[means]] (300) for ~~output~~ outputting of a wide image video
sequence.